Semester	**FOUR**
Paper Number	**15**
Paper Code	**MDTS 4413**
Paper Title	**Deep Learning**
No. of Credits	**6**
Course Description	DISCIPLINE SPECIFIC ELECTIVE Composite Paper One Module No. of classes assigned Theory: 4 classes per week Practical: 3 classes per week
Course Objective	At the end of the course, the students should be able to, (1) Appreciate the need of deep learning over machine learning (2) Understand the working of neural networks (3) Gain an in-depth knowledge of the methods to prevent overfitting of deep neural networks (4) Grasp advanced deep learning algorithms, such as convolutional neural network and recurrent neural network (5) Implement deep learning models from scratch by writing computer programs
Syllabus	**Introduction to Deep Learning (DL):** Drawbacks of machine learning; From Spring to Winter of AI; Biological inspiration; McCulloch Pitts Neuron; The Perceptron; Power of a network of Perceptrons; The Sigmoid Neuron; Power of a network of Sigmoid neurons **(4)** **Feedforward Neural Networks:** Learning parameters; Backpropagation (BP); Gradient calculation: output units, hidden units, parameters **(6)** **Training deep neural networks:** Optimizers: gradient descent and its variations; Train error v/s test error; Dataset augmentation; Early stopping; Dropout; Initialization strategies; Batch Normalization; More activation functions **(15)** **Convolutional Neural Networks (CNN):** The convolution operation: kernel, padding, stride; The pooling operation: max pooling, average pooling; BP in CNN; Success stories on the ImageNet dataset; Transfer learning **(10)** **Sequence Modelling:** Recurrent Neural Network (RNN); Types of RNN; Drawbacks of RNN: vanishing gradient and exploding gradient; BP through time; Long Short Term Memory Network **(10)** **Applications:** Computer Vision, Natural Language Processing **(7)**
List of Practical	Implementing case studies on the topics taught in theory classes using Python
Reading/Reference Lists	1. Goodfellow, I, Bengio, Y, and Courville, A (2016): Deep Learning. MIT Press 2. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017 3. Francois Chollet "Deep Learning with Python", Manning Publications, 2017. 4. Nikhil Buduma and Nicholas Locascio. 2017. Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms (1st. ed.). O'Reilly Media, Inc.

Evaluation	Theory Continuous Internal Assessment: 10 End semester exam: 50 Total: 60	Practical Continuous Assessment: 30 End semester viva voce: 10 Total: 40
Paper structure for end semester theory	Short questions: 5 marks each	Long questions: 10 marks each
	2 out of 4	4 out of 6